

lower electrode substrates can be controlled precisely, and the liquid crystal display is free from color variation.

Because the area utilization factor (wiring efficiency) of the leadout wirings can be improved by forming the wirings as mentioned above, the lengths of the leadout wirings can be shortened, thus reducing the wiring resistance about 30–40% from conventional values of 500–1000Ω. The wiring resistance reduction can contribute to the margin of the ON resistances of the drive semiconductor ICs and this in turn allows the dimension of the semiconductor IC chips to be reduced. Further, because the readout wirings can be shorter than conventional ones, it is possible to reduce the dimensions of the liquid crystal device. As a result, the manufacturing cost is reduced. Furthermore, reduction in the wiring resistance can reduce distortion of liquid crystal drive waveforms and crosstalk, which in turn reduces shadowing (uneven brightness), thereby improving the display quality.

Further, the first dummy electrodes are provided in a wide space between the terminal groups connected to TCPs arranged in line at the end portion of the electrode substrate. This arrangement prevents uneven pattern due to height difference between the areas where terminals exist and where they do not from being transferred to the rubbing roller, which performs alignment treatment (rubbing) of the molecular alignment layers formed over the display electrodes. This in turn prevents rubbing streaks from being formed on the molecular alignment layers and therefore the display quality from deteriorating. Furthermore, because the first dummy electrodes eliminate recesses between the TCPs, the gap between the upper and lower substrates can be made uniform.

The second dummy electrodes are provided in spaces between the terminals and this prevents light from leaking from between the terminals in the frame edge portion. Further, because the in-plane wiring densities of the area where the terminals are provided and the area where the extended terminals are provided are equal to each other, the gap between the upper and lower substrates is uniform. It is also possible to eliminate tonal variation due to uneven wiring density of the conventional, radially arranged inclined linear wirings at the frame edge portion, making the frame edge portion uniformly black, the frame edge portion being intended to be uniformly black. As a result, the display quality is enhanced.

Moreover, because the first and second dummy electrodes make the gap at the frame edge portion uniform, such problems as color variation caused by gap variation in the frame edge portion is eliminated, improving the display quality.

We claim:

1. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates so arranged as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

a plurality of liquid crystal drive elements connected to wirings on the liquid crystal device substrate and provided to drive the liquid crystal;

wherein the liquid crystal device substrates are provided with:

a plurality of parallel display electrodes;

a plurality of parallel terminal electrodes led out to the end portion of the liquid crystal device substrates, connected to the liquid crystal drive elements, and arranged at pitches smaller than those of the display electrodes parallelly to the display electrodes; and

a plurality of wirings including almost mutually parallel, inclined linear wiring electrodes for connecting the display electrodes and the terminal electrodes; and

wherein the lengths of the terminal electrodes and the widths of the inclined linear wiring electrodes are adjusted so that each resistances of each set of the terminal electrodes and each set of the inclined linear wiring electrodes are substantially equal.

2. A liquid crystal display according to claim 1, wherein the liquid crystal device substrates further include a plurality of first dummy electrodes disposed parallelly to the terminal electrodes between the terminal electrodes in at least a central portion of liquid crystal drive circuits.

3. A liquid crystal display according to claim 2, wherein the liquid crystal device substrates further include a partial short-circuiting portion for electrically connecting the first dummy electrodes to the terminal electrodes.

4. A liquid crystal display according to one of claims 1 to 3, wherein the intervals between two terminal electrode groups connected to at least the two liquid crystal drive circuits are greater than the intervals between the individual terminal electrodes in the terminal electrode groups, and the wirings provided on the liquid crystal device substrates further include second dummy electrodes arranged between the terminal electrode groups.

5. A liquid crystal display according to one of claims 2 and 3, wherein, in the area outside the display area of a first liquid crystal device substrate with scanning electrodes, out of the liquid crystal device substrates, third dummy wirings having the same shapes as that of a second liquid crystal device substrate with signal electrodes are provided, and in the area outside the display area of the second liquid crystal device substrate fourth dummy wirings having the same shapes as that of the first liquid crystal device substrates.

6. A liquid crystal display according to claim 1, wherein metal auxiliary electrodes, whose widths are narrower than at least those of the wirings on the liquid crystal device substrates, are provided on the surfaces of the liquid crystal device substrates opposite to a liquid crystal layer.

7. A liquid crystal display according to claim 6, wherein the metal auxiliary electrodes have a multilayer structure in which an aluminum film is held between chromium films.

8. A liquid crystal display according to one of claims 6 to 7, wherein the wirings including the metal auxiliary electrodes are provided on only the first liquid crystal device substrate having the scanning electrodes.

9. A liquid crystal display according to claim 4, wherein the second dummy electrodes are spaced at specified intervals so that they do not overlap with an aligning mark for precise connection between terminals of the liquid crystal drive elements and the terminal electrodes on the liquid crystal device substrates.

10. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates so arranged as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

a plurality of liquid crystal drive elements connected to wirings on the liquid crystal device substrates and provided to drive the liquid crystal;

wherein the liquid crystal device substrates are provided with:

a plurality of parallel display electrodes;  
 a plurality of parallel terminal electrodes led out to the end portion of the liquid crystal device substrates, connected to the liquid crystal drive elements, and arranged at the terminal electrodes pitches smaller than those of the display electrodes parallelly to the display electrodes;  
 a plurality of wirings including almost mutually parallel, inclined linear wiring electrodes for connecting the display electrodes and the terminal electrodes; and  
 a color filter formed on one of the liquid crystal device substrates; and  
 wherein the lengths of the terminal electrodes and the widths of the inclined linear wiring electrodes are so adjusted so that each resistances of each set of the terminal electrodes and each set of the inclined linear wiring electrodes are substantially equal to each other.

11. A liquid crystal display according to claim 10, wherein the liquid crystal device substrates further include a plurality of first dummy electrodes disposed parallelly to the terminal electrodes between the terminal electrodes in at least a central portion of liquid crystal drive circuits.

12. A liquid crystal display according to claim 11, wherein the liquid crystal device substrates further include a partial short-circuiting portion for electrically connecting the first dummy electrodes to the terminal electrodes.

13. A liquid crystal display according to one of claims 10 to 12, wherein the intervals between two terminal electrode groups connected to at least the two liquid crystal drive circuits are greater than the intervals between the individual terminal electrodes in the terminal electrode groups, and the wirings provided on the liquid crystal device substrates further include second dummy electrodes arranged between the terminal electrode groups.

14. A liquid crystal display according to one of claims 11 and 12, wherein, in the area outside the display area of a first liquid crystal device substrate with scanning electrodes, out of the liquid crystal device substrates, third dummy wirings having the same shapes as that of a second liquid crystal device substrate with signal electrodes are provided, and in the area outside the display area of the second liquid crystal device substrate fourth dummy wirings having the same shapes as that of the first liquid crystal device substrates.

15. A liquid crystal display according to claim 10, wherein metal auxiliary electrodes, whose widths are narrower than at least those of the wirings on the liquid crystal device substrates, are provided on the surfaces of the liquid crystal device substrates opposite to a liquid crystal layer.

16. A liquid crystal display according to claim 15, wherein the metal auxiliary electrodes have a multilayer structure in which an aluminum film is held between chromium films.

17. A liquid crystal display according to one of claims 15 to 16, wherein the wirings including the metal auxiliary electrodes are provided on only the first liquid crystal device substrate having the scanning electrodes.

18. A liquid crystal display according to claim 13, wherein the second dummy electrodes are spaced at specified intervals so that they do not overlap with an aligning mark for precise connection between terminals of the liquid crystal drive elements and the terminal electrodes on the liquid crystal device substrates.

19. A liquid crystal display having plural tape carrier packages comprising:

- a pair of substrates so arranged as to be opposite to each other;
- a liquid crystal layer interposed between said pair of substrates and a sealant to join said pair of substrates together; and

a plurality of tape carrier packages each having a drive circuit connected to terminal electrodes on the substrates; and

wherein one of said substrates includes:

first and second display electrodes disposed inside said sealant in parallel with each other, each display electrode having a first width  $W_{LCD}$ ;

first and second terminal electrodes disposed so as to extend from inside to outside of said sealant in parallel with each other, each terminal electrode having a second width ( $W_{TCP}$ ) and arranged at pitches smaller than those of the display electrodes parallelly to the display electrodes; and

first and second inclined electrodes for connecting each of the first and second display electrodes to each of the first and second terminal electrodes, the first inclined electrode having a third width ( $W_{n-1}$ ) and the second inclined electrode having a fourth width ( $W_n$ ), the first inclined electrode being adjacent to said second inclined electrode;

wherein a first set of the first terminal electrode, the first display electrode and the first inclined electrode has a relationship with a second set of the second terminal electrode, the second display electrode and the second inclined electrode in accordance with the following formula:

$$\frac{e_{(n-1)}}{W_{TCP}} + \frac{m_{n-1}}{W_{n-1}} + \frac{p_{n-1}}{W_{LCD}} = \frac{m_n}{W_n} + \frac{p_n}{W_{LCD}}$$

wherein

1)  $m_{n-1}$  is a length between a first middle point and a third middle point, the first middle point being between each crossing point of outlines of the first inclined electrode and the first terminal electrode at the terminal electrode side and the third middle point being between each crossing point of outlines of the first inclined electrode and the first display electrode at the display electrode side,

2)  $m_n$  is a length between a second middle point and a fourth middle point, said second middle point being between each crossing point of outlines of the second inclined electrode and the second terminal electrode at the terminal electrode side and the fourth middle point being between each crossing point of outlines of the second inclined electrode and the second display electrode at the display electrode side,

3)  $p_{n-1}$  is a length between the third middle point and a predetermined line which is parallel to an adjacent edge-line of the substrates in a perpendicular direction of the predetermined line,

4)  $p_n$  is a length between the fourth middle point and the predetermined line in a perpendicular direction of the predetermined line, and

5)  $e_{(n-1)}$  is a length between the first middle point and the second middle point in a parallel direction of the outlines of the first and second inclined electrode.

20. A liquid crystal display according to claim 19, wherein the substrates further include a plurality of first dummy electrodes disposed parallelly to the terminal electrodes between the terminal electrodes in at least a central portion of liquid crystal drive circuits.

21. A liquid crystal display according to claim 19, wherein the substrates further include a partial short-circuiting portion for electrically connecting the first dummy electrode to the terminal electrode.

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22. A liquid crystal display according to claim 19, wherein the intervals between two terminal electrode groups connected to the at least two drive circuits are greater than the intervals between the individual terminal electrodes in the terminal electrode groups, and the substrates further include dummy electrodes arranged between the terminal electrode groups.

23. A liquid crystal display according to claim 19, wherein, in the area outside the display area of the first substrate with scanning electrodes, first dummy electrodes having the same shapes as that of the second substrate with signal electrodes are provided, and in the area outside the

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display area of the second substrate, second dummy electrodes having the same shapes as that of the first substrate are provided.

24. A liquid crystal display according to claim 19, wherein the predetermined line is an extended line of outline of the first display electrode in parallel with the adjacent edge of substrates when the first display electrode is disposed at the most center position of the display electrode group electrically connected to one of the drive circuits.

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25. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween and;

at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal display device substrates comprise:

a plurality of parallel display electrodes;

a plurality of parallel terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to the liquid crystal drive element, and having different pitches from pitches of the display electrodes; and

a plurality of leadout wirings for connecting the display electrodes and the terminal electrodes, including first portions being substantially parallel to the display electrodes, second portions being substantially parallel to the terminal electrodes and inclined linear wiring electrodes for connecting the first and second portions; and

wherein the inclined linear wiring electrodes are substantially parallel to each other; and

wherein lengths of at least one of first and second portions and widths of the inclined linear wiring electrodes vary.

26. A liquid crystal display according to claim 25, wherein the pitches of the terminal electrodes are smaller than the pitches of display electrodes.

27. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrates comprise:

a plurality of parallel scanning signal lines;

a plurality of switching devices;

a plurality of parallel terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to the liquid crystal drive element, and having different pitches from pitches of the scanning signal lines; and

a plurality of leadout wirings for connecting the scanning signal lines and the terminal electrodes, including first portions being substantially parallel to the scanning signal lines, second portions being substantially parallel to the terminal electrodes and inclined linear wiring electrodes for connecting the first and second portions; and

wherein the inclined linear wiring electrodes are substantially parallel to each other; and

wherein lengths of at least one of first and second

portions and widths of the inclined linear wiring electrodes vary.

28. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrates comprise:

a plurality of parallel video signal lines;

a plurality of switching devices;

a plurality of terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to the liquid crystal drive element, and having different pitches from pitches of the video signal lines; and

a plurality of leadout wirings for connecting the video signal lines and the terminal electrodes, including first portions being substantially parallel to the video signal lines, second portions being substantially parallel to the terminal electrodes and inclined linear wiring electrodes for connecting the first and second portions; and

wherein the inclined linear wiring electrodes are substantially parallel to each other; and

wherein lengths of at least one of first and second portions and widths of the inclined linear wiring electrodes vary.

29. A liquid crystal display according to one of claims 25, 27 and 28, wherein resistances of each lead out wirings are substantially equal to each other.

30. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrates comprise:

a plurality of parallel display electrodes;

a plurality of parallel terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to the liquid crystal drive element, and having different pitches from pitches of the display electrodes; and

a plurality of leadout wirings for connecting the display electrodes and the terminal electrodes, including inclined linear wiring electrodes which are not parallel to the display electrodes; and

wherein the inclined linear wiring electrodes are substantially parallel to each other.

31. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrate comprise:

a plurality of parallel scanning signal lines;

a plurality of switching devices;

a plurality of parallel terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to the liquid crystal drive element, and having different pitches from pitches of the scanning signal lines; and

a plurality of leadout wirings for connecting the scanning signal lines and the terminal electrodes, including inclined linear wiring electrodes which are not parallel to the scanning signal lines; and

wherein the inclined linear wiring electrodes are substantially parallel to each other.

32. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and



at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrates comprise:

a plurality of parallel video signal lines;

a plurality of switching devices;

a plurality of parallel terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to the liquid crystal drive element, and having different pitches from pitches of the video signal lines; and

a plurality of leadout wirings for connecting the video signal lines and the terminal electrodes, including inclined linear wiring electrodes which are not parallel to the video signal lines; and

wherein the inclined linear wiring electrodes are substantially parallel to each other.

33. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrates comprise:

a plurality of parallel display electrodes;

at least one terminal electrode group comprising a plurality of parallel terminal electrodes led out to an end

portion of the liquid crystal device substrates, connected to the liquid crystal drive element, and having different pitches from pitches of the display electrodes; and

a plurality of leadout wirings for connecting the display electrodes and the terminal electrodes; and

wherein the leadout wirings connected to the terminal electrodes positioned at least an outer portion have inclined linear wiring electrodes which are not parallel to the display electrode; and

wherein the inclined linear wiring electrodes are substantially parallel to each other.

34. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrates comprise:

a plurality of parallel scanning signal lines;

a plurality of switching devices;

at least one terminal electrode group comprising a plurality of parallel terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to the liquid crystal drive element, and having different pitches from pitches of the scanning signal lines; and

a plurality of leadout wirings for connecting the scanning signal lines and the terminal electrodes; and  
wherein the leadout wirings connected to the terminal electrodes positioned at least an outer portion have inclined linear wiring electrodes which are not parallel to the scanning signal lines; and  
wherein the inclined linear wiring electrodes are substantially parallel to each other.

35. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and  
at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrates comprise:  
a plurality of parallel video signal lines;  
a plurality of switching devices;  
at least one terminal electrode group comprising a plurality of parallel terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to the liquid crystal drive element, and having different pitches from pitches of the video signal lines; and

a plurality of leadout wirings for connecting the video signal lines and the terminal electrodes; and  
wherein the leadout wirings connected to the terminal

electrodes positioned at least an outer portion have inclined linear wiring electrodes which are not parallel to the video signal lines; and

wherein the inclined linear wiring electrodes are substantially parallel to each other.

36. A liquid crystal display according to one of claims 33 to 35, wherein the pitches of the inclined linear wiring electrodes are substantially equal to each other.

37. A liquid crystal display according to one of claims 33 to 35, wherein the leadout wirings have portions which are parallel to the terminal electrodes, and wherein lengths of the portions vary.

38. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrates comprise:

a plurality of parallel display electrodes;

at least one terminal electrode group comprising a plurality of parallel terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to

the liquid crystal drive element, and having smaller pitches than pitches of the display electrodes; and

at least one dummy electrode formed at the side terminal electrode group.

39. A liquid crystal display according to claim 38, wherein the at least one dummy electrode is formed between two terminal electrode groups.

40. A liquid crystal display suitable for high-quality display comprising:

a pair of liquid crystal device substrates arranged so as to be opposite to each other and joined together by a sealant with a liquid crystal interposed therebetween; and

at least one liquid crystal drive element for driving the liquid crystal;

wherein the liquid crystal device substrates comprise:

a plurality of parallel display electrodes;

a plurality of terminal electrodes led out to an end portion of the liquid crystal device substrates, connected to the liquid crystal drive element;

a plurality of leadout wirings for connecting the display electrodes and the terminal electrodes; and

at least one replicated dummy pattern replicating the leadout wirings on the liquid crystal device substrate facing the liquid crystal device substrate on which the leadout wirings are formed.

41. A liquid crystal display according to claim 40,  
wherein the liquid crystal device substrates further comprise:  
at least one terminal electrode group comprising the  
terminal electrodes; and  
at least one first dummy electrode formed at the side of  
the terminal electrode group; and  
wherein the at least one replicated dummy pattern  
includes at least one dummy pattern replacing the first dummy  
electrode on the liquid crystal device substrate facing the  
liquid crystal device substrate on which the first dummy  
electrode is formed.

42. A liquid crystal display according to claim 40,  
wherein the liquid crystal device substrates further  
comprises:  
at least one second dummy electrode formed between one of  
the terminal electrodes and the leadout wirings; and  
wherein the at least one replicated dummy pattern  
includes at least one dummy pattern replicating the second  
dummy electrode on the liquid crystal device substrate facing  
the liquid crystal device substrate on which the second dummy  
electrode is formed.

43. A liquid crystal display according to claim 40,  
wherein the at least one replicated dummy pattern includes at  
least one dummy pattern replicating the terminal electrodes on  
the liquid crystal device substrate facing the liquid crystal

device substrate on which the terminal electrodes are formed.

44. A liquid crystal display according to claim 40,  
wherein the at least one replicated dummy pattern includes at  
least one dummy pattern replicating at least a part of the  
display electrodes on the liquid crystal device substrate  
facing the liquid crystal device substrate on which the  
display electrodes are formed.

45. A liquid crystal display according to claim 40,  
wherein the at least one replicated dummy pattern has a same  
shape as a pattern which is replicated.

46. A liquid crystal display according to claim 40,  
wherein the at least one replicated dummy pattern electrically  
floats.